ASP FUTURE DIRECTIONS: GROUP 3

"To provide and improve the scientific knowledge needed to simulate and predict radiative forcing by aerosols and their effects on climate"

Forcing = emissions × changes due to processing × lifetime

Most Important Science Questions for ASP/ARM over Next 5-10 Yrs	Specific Knowledge Gaps	What Approaches Are Needed?
What are the primary emissions of particles?	Composition and size distribution of 1° emissions are crucial Need separate contributions from natural and anthropogenic sources, including biomass burning	Source measurements

Why is the modern (vs fossil fuel) carbon signature in particles so large?	Distribution between modern and fossil fuel carbon; what factors determine this? Nature of synergistic interactions between anthropogenic and natural sources/processes	^{14}C measurements with time resolution sufficient to correlate to emissions and processes Identification of specific molecular markers for combustion vs biogenics; measurement with time resolution sufficient to correlate to emissions and processes Need both lab and field studies, and development of new instrumentation.

Why is there such a discrepancy between measured and modeled SOA?	Missing organic precursors of SOA such as SVOC Missing processes for SOA formation Treatment of processes in models	SVOC measurements (instrument development) Detailed organic composition ("chemical resolution"), including markers of different sources and processes, including gas to particle partitioning, with sufficient time resolution to understand sources and processes Closure studies between measured and modeled SOA
What are the aerosol-cloud interactions that affect radiative forcing?	Need size, # concentration, composition and 3-D structure of particles Relative importance of nucleation/new particle formation vs primary emissions for CCN Role of organics, nitrogen and non-H_2SO_4 in new particle formation	Lab studies, instrumentation development, field programs, theory and modeling Measurements of 3D chemical structure of particles (peel like onion)

What are the life cycles and atmospheric processes for aerosols that determine their radiative forcing?	Need to understand multi-faceted aging of particles: change in hygroscopic properties, gas-particle partitioning, dry & wet deposition, mixing state, chemistry and photochemistry occurring in and on particles Spatial and temporal inhomogeneities in all particle properties	Wide variety of lab and field studies to probe chemical and physical structure in 3-D Measurements on scales to resolve spatial and temporal inhomogeneity and allow statistical representation in models Fixed ground based aerosol and associated gases characterization sites Fully instrumented mobile facility for aerosol characterization Model sensitivity studies to extract the potentially most important processes

ASP/ARM SYNERGISM: WHAT DOES UNIQUE CAPABILITIES DOES ASP BRING TO THE TABLE?

Unique integration of field, lab and model studies

Rapid deployment capability

Trace gas capabilities

Innovative instrumentation development

Detailed microphysical understanding of aerosol processes from molecular to regional and global scales and over large range of time scales